Cheetah Omni LLC

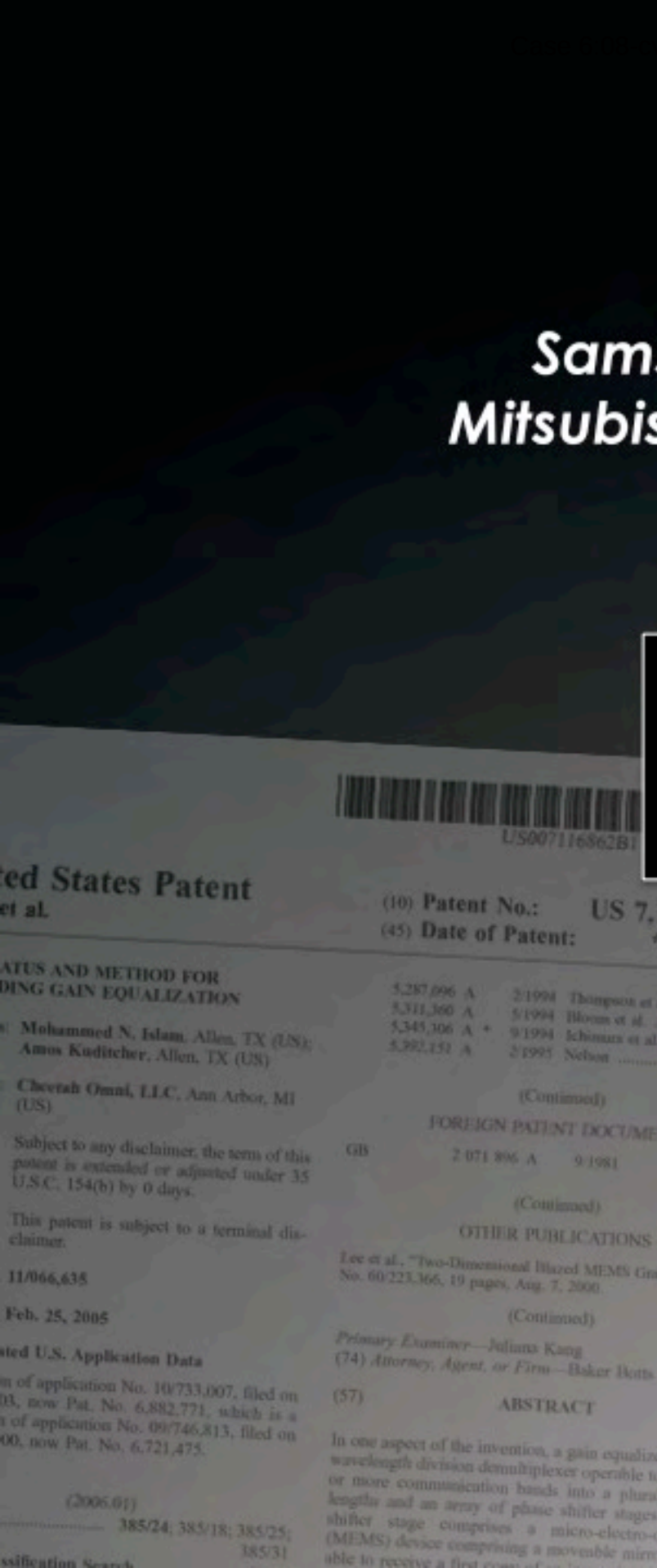
v.

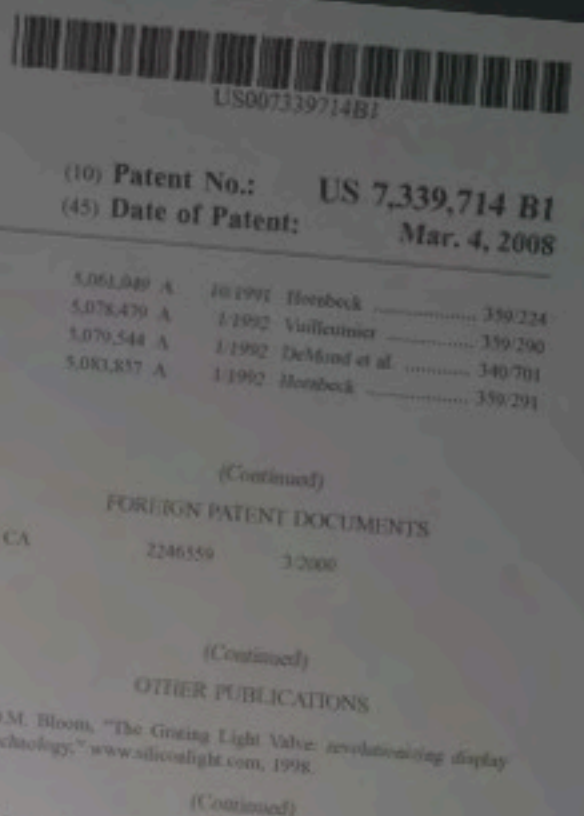
Samsung Electronics America, Inc. &

Mitsubishi Digital Electronics America, Inc.,

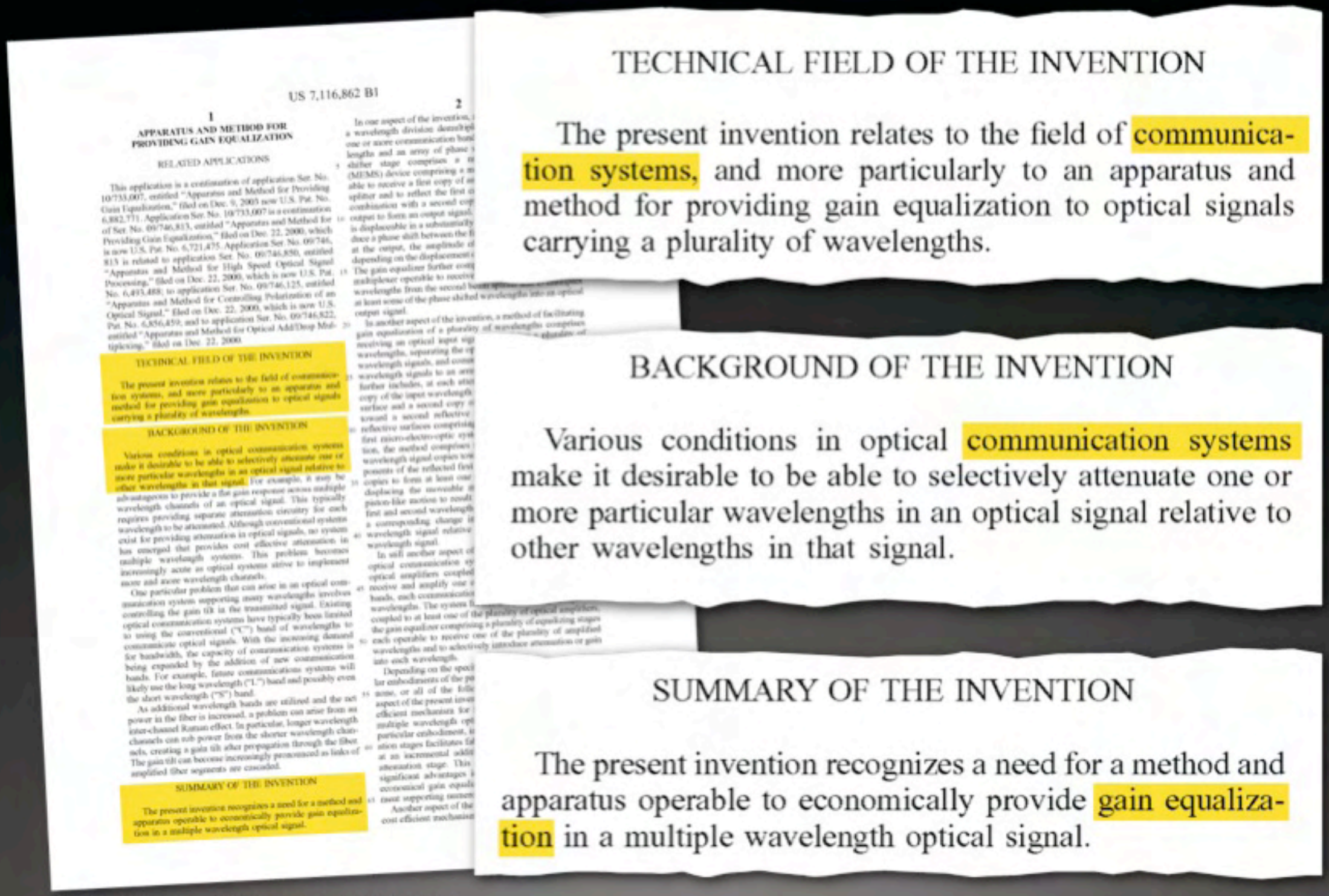
No. 6:08-CV-279 (E.D. Tex.)

Defendants' Claim Construction Presentation





The '862 Patent Relates to Optical Signal Processing



US 7,116,862 B1

1

APPARATUS AND METHOD FOR PROVIDING GAIN EQUALIZATION

RELATED APPLICATIONS

This application is a continuation of application Ser. No. 10/733,007, entitled "Apparatus and Method for Providing Gain Equalization," filed on Dec. 9, 2003 now U.S. Pat. No. 6,882,771. Application Ser. No. 10/733,007 is a continuation of Ser. No. 09/746,813, entitled "Apparatus and Method for Providing Gain Equalization," filed on Dec. 22, 2000, which is now U.S. Pat. No. 6,721,475. Application Ser. No. 09/746,813 is related to application Ser. No. 09/746,850, entitled "Apparatus and Method for High Speed Optical Signal Processing," filed on Dec. 22, 2000, which is now U.S. Pat. No. 6,493,488; to application Ser. No. 09/746,125, entitled "Apparatus and Method for Controlling Polarization of an Optical Signal," filed on Dec. 22, 2000, which is now U.S. Pat. No. 6,856,459; and to application Ser. No. 09/746,822, entitled "Apparatus and Method for Optical Add/Drop Multiplexing," filed on Dec. 22, 2000.

TECHNICAL FIELD OF THE INVENTION

The present invention relates to the field of communication systems, and more particularly to an apparatus and method for providing gain equalization to optical signals carrying a plurality of wavelengths.

BACKGROUND OF THE INVENTION

Various conditions in optical communication systems make it desirable to be able to selectively attenuate one or more particular wavelengths in an optical signal relative to other wavelengths in that signal. For example, it may be advantageous to provide a flat gain response across multiple wavelength channels of an optical signal. This typically requires providing separate attenuation circuitry for each wavelength to be attenuated. Although conventional systems exist for providing attenuation in optical signals, no system has emerged that provides cost effective attenuation in multiple wavelength systems. This problem becomes increasingly acute as optical systems strive to implement more and more wavelength channels.

One particular problem that can arise in an optical communication system supporting many wavelengths involves controlling the gain tilt in the transmitted signal. Existing optical communication systems have typically been limited to using the conventional ("C") band of wavelengths to communicate optical signals. With the increasing demand for bandwidth, the capacity of communication systems is being expanded by the addition of new communication bands. For example, future communications systems will likely use the long wavelength ("L") band and possibly even the short wavelength ("S") band.

As additional wavelength bands are utilized and the net power in the fiber is increased, a problem can arise from an inter-channel Raman effect. In particular, longer wavelength channels can rob power from the shorter wavelength channels, creating a gain tilt after propagation through the fiber. The gain tilt can become increasingly pronounced as links of amplified fiber segments are cascaded.

SUMMARY OF THE INVENTION

The present invention recognizes a need for a method and apparatus operable to economically provide gain equalization in a multiple wavelength optical signal.

2

TECHNICAL FIELD OF THE INVENTION

The present invention relates to the field of communication systems, and more particularly to an apparatus and method for providing gain equalization to optical signals carrying a plurality of wavelengths.

BACKGROUND OF THE INVENTION

Various conditions in optical communication systems make it desirable to be able to selectively attenuate one or more particular wavelengths in an optical signal relative to other wavelengths in that signal.

SUMMARY OF THE INVENTION

The present invention recognizes a need for a method and apparatus operable to economically provide gain equalization in a multiple wavelength optical signal.

'862 Patent, col. 1 ll. 25-28, 29-34, 62-67.

The '862 Patent Operates on Communication Channels in Different Infrared Wavelength Bands

1

APPARATUS AND METHOD FOR PROVIDING GAIN EQUALIZATION

RELATED APPLICATIONS

This application is a continuation of application Ser. No. 10/733,007, entitled "Apparatus and Method for Providing Gain Equalization," filed on Dec. 9, 2003 now U.S. Pat. No. 6,882,771. Application Ser. No. 10/733,007 is a continuation of Ser. No. 09/746,813, entitled "Apparatus and Method for Providing Gain Equalization," filed on Dec. 22, 2000, which is now U.S. Pat. No. 6,721,475. Application Ser. No. 09/746,813 is related to application Ser. No. 09/746,850, entitled "Apparatus and Method for High Speed Optical Signal Processing," filed on Dec. 22, 2000, which is now U.S. Pat. No. 6,493,488; to application Ser. No. 09/746,125, entitled "Apparatus and Method for Controlling Polarization of an Optical Signal," filed on Dec. 22, 2000, which is now U.S. Pat. No. 6,856,459; and to application Ser. No. 09/746,822, entitled "Apparatus and Method for Optical Add/Drop Multiplexing," filed on Dec. 22, 2000.

TECHNICAL FIELD OF THE INVENTION

The present invention relates to the field of communication systems, and more particularly to an apparatus and method for providing gain equalization to optical signals carrying a plurality of wavelengths.

BACKGROUND OF THE INVENTION

Various conditions in optical communication systems make it desirable to be able to selectively attenuate one or more particular wavelengths in an optical signal relative to other wavelengths in that signal. For example, it may be advantageous to provide a flat gain response across multiple wavelength channels of an optical signal. This typically requires providing separate attenuation circuitry for each wavelength to be attenuated. Although conventional systems exist for providing attenuation in optical signals, no system has emerged that provides cost effective attenuation in multiple wavelength systems. This problem becomes increasingly acute as optical systems strive to implement more and more wavelength channels.

One particular problem that can arise in an optical communication system supporting many wavelengths involves controlling the gain tilt in the transmitted signal. Existing optical communication systems have typically been limited to using the conventional ("C") band of wavelengths to communicate optical signals. With the increasing demand for bandwidth, the capacity of communication systems is being expanded by the addition of new communication bands. For example, future communications systems will likely use the long wavelength ("L") band and possibly even the short wavelength ("S") band.

As additional wavelength bands are utilized and the net power in the fiber is increased, a problem can arise from an inter-channel Raman effect. In particular, longer wavelength channels can rob power from the shorter wavelength channels, creating a gain tilt after propagation through the fiber. The gain tilt can become increasingly pronounced as links of amplified fiber segments are cascaded.

SUMMARY OF THE INVENTION

The present invention recognizes a need for a method and apparatus operable to economically provide gain equalization in a multiple wavelength optical signal.

2

In one aspect of the invention, a gain equalizer comprises a wavelength division demultiplexer operable to separate one or more communication bands into a plurality of wavelengths and an array of ... shifter stage comprises ... (MEMS) device comprising ... able to receive a first copy ... splitter and to reflect the ... combination with a second ... output to form an output ... is displaceable in a substantially ... duce a phase shift between ... at the output, the amplitude ... depending on the displacement ... The gain equalizer further comprises ... multiplexer operable to receive a plurality of phase shifted wavelengths from the second beam splitter and to multiplex ... at least some of the ... output signal.

In another aspect of the invention, a gain equalization ... receiving an optical signal ... wavelengths, separating ... wavelength signals ... wavelength signal ... further including ... copy of the input ... surface and a second ... toward a second ... reflective surface ... first micro-electromechanical ... tion, the method ... wavelength signal ... ponents of the ... copies to form ... displacing the ... piston-like manner ... first and second ... a corresponding ... wavelength ... wavelength ...

In still another ... optical communication ... optical ... receive and ... bands, each ... wavelengths ... coupled to ... the gain equalizer ... each operable ... wavelengths ... into each ...

Dependent ... lar embodiment, ... acute, or ... aspect of the ... efficient ... multiple wavelength optical communication system. In a particular embodiment, implementing MEMS based attenuation stages facilitates fabrication of arrays of these devices at an incremental additional cost to fabricating a single attenuation stage. This aspect of the invention provides significant advantages in facilitating rapid, effective, and economical gain equalization, particularly in an environment supporting numerous wavelengths.

Another aspect of the invention provides an effective and cost efficient mechanism for dynamically adjusting the gain

BACKGROUND OF THE INVENTION

controlling the gain tilt in the transmitted signal. Existing optical communication systems have typically been limited to using the conventional ("C") band of wavelengths to communicate optical signals. With the increasing demand for bandwidth, the capacity of communication systems is being expanded by the addition of new communication bands. For example, future communications systems will likely use the long wavelength ("L") band and possibly even the short wavelength ("S") band.

'862 Patent, col. 1 ll. 44-54.

The ’714 Patent Teaches a Variable Blazed Grating

US007339714B1

(12) **United States Patent**
Islam

(10) **Patent No.: US 7,339,714 B1**
(45) **Date of Patent: Mar. 4, 2008**

(54) **VARIABLE BLAZED GRATING BASED SIGNAL PROCESSING**

(75) Inventor: **Mohammed N. Islam**, Ann Arbor, MI (US)

(73) Assignee: **Cheetah Omni, LLC**, Ann Arbor, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 93 days.

(21) Appl. No.: **11/066,846**

(22) Filed: **Feb. 25, 2005**

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/723,107, filed on Nov. 25, 2003, now Pat. No. 6,943,925, which is a continuation-in-part of application No. 09/776,052, filed on Feb. 2, 2001, now Pat. No. 6,721,473.

(51) **Int. Cl.**
G02B 26/00 (2006.01)

(52) **U.S. Cl.** **359/291**; 359/290; 353/3

(58) **Field of Classification Search** 359/291, 359/290, 224, 223, 295, 634; 353/31, 98, 353/99

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,011,009 A	3/1977	Lama et al.	350/162 R
4,573,070 A	2/1986	Cooper	358/36
4,662,746 A	5/1987	Hornbeck	350/269
4,728,185 A	3/1988	Thomas	353/122
4,736,132 A	4/1988	Culp	310/328
4,827,334 A	5/1989	Johnson et al.	358/60
4,856,863 A	8/1989	Sampsell et al.	350/96.15
4,900,139 A	2/1990	Iino et al.	350/4.3
4,956,619 A	9/1990	Hornbeck	358/231
5,032,924 A	7/1991	Brown et al.	
5,061,049 A	10/1991	Hornbeck	359/224
5,078,479 A	1/1992	Vuilleumier	359/290
5,079,544 A	1/1992	DeMond et al.	340/701
5,083,857 A	1/1992	Hornbeck	359/291

(Continued)

FOREIGN PATENT DOCUMENTS

CA 2246559 3/2000

(Continued)

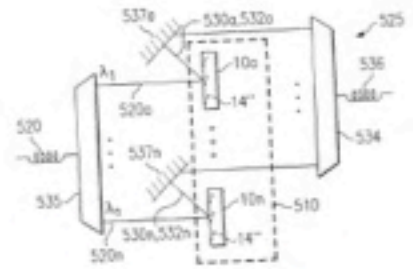
OTHER PUBLICATIONS

D.M. Bloom, "The Grating Light Valve: revolutionizing display tech[illegible].com, 1998.

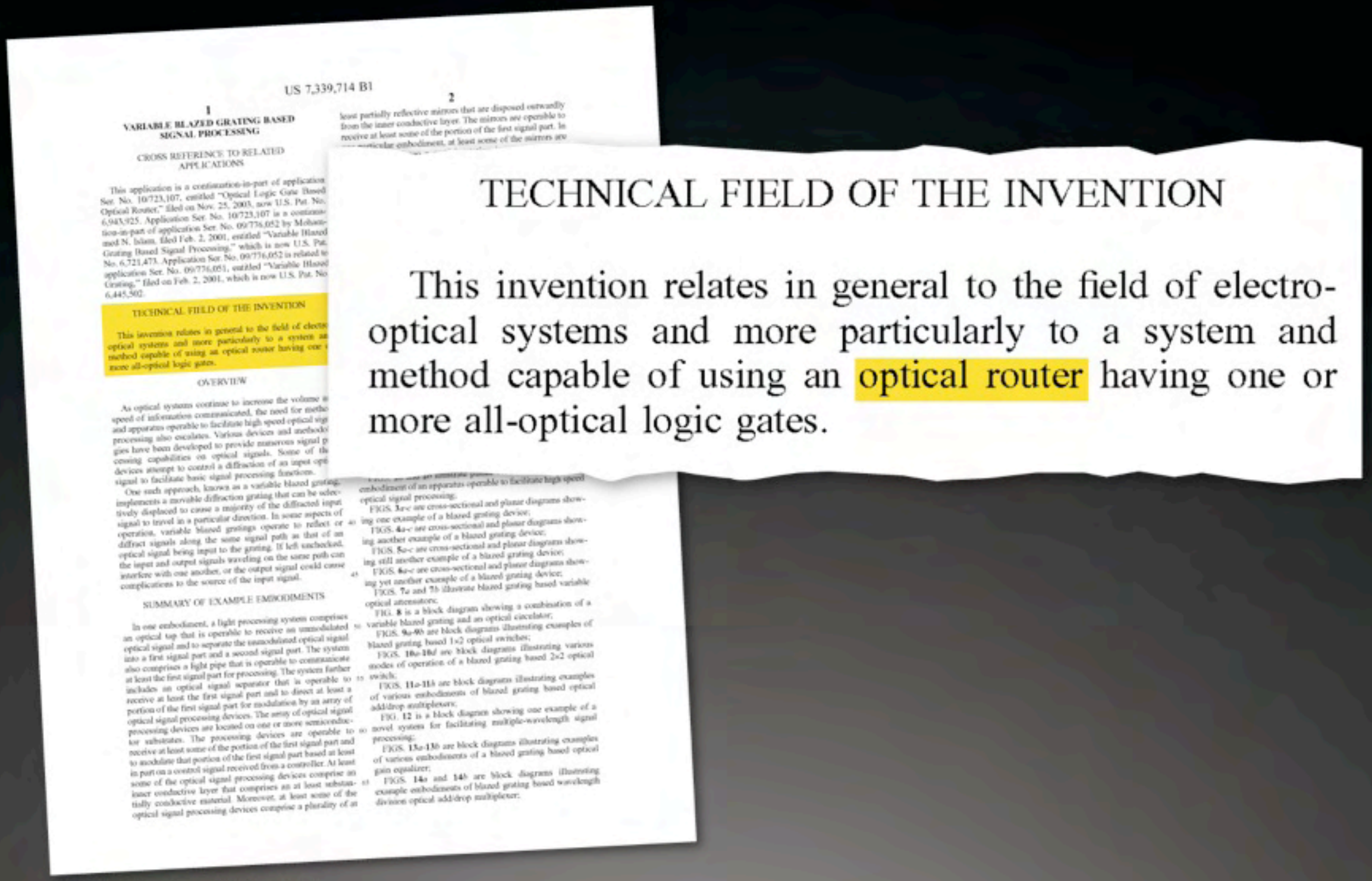
VARIABLE BLAZED GRATING BASED SIGNAL PROCESSING

in response to the control signal. The partial reflection resulting in a reflection of the at least some of the first signal part in one direction.

20 Claims, 12 Drawing Sheets



The '714 Patent Relates to an Optical Router



US 7,339,714 B1

1

VARIABLE BLAZED GRATING BASED SIGNAL PROCESSING

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of application Ser. No. 10/723,107, entitled "Optical Logic Gate Based Optical Router," filed on Nov. 25, 2003, now U.S. Pat. No. 6,943,925. Application Ser. No. 10/723,107 is a continuation-in-part of application Ser. No. 09/776,052 by Mohammed N. Islam, filed Feb. 2, 2001, entitled "Variable Blazed Grating Based Signal Processing," which is now U.S. Pat. No. 6,721,473. Application Ser. No. 09/776,052 is related to application Ser. No. 09/776,051, entitled "Variable Blazed Grating," filed on Feb. 2, 2001, which is now U.S. Pat. No. 6,445,502.

TECHNICAL FIELD OF THE INVENTION

This invention relates in general to the field of electro-optical systems and more particularly to a system and method capable of using an optical router having one or more all-optical logic gates.

OVERVIEW

As optical systems continue to increase the volume of speed of information communicated, the need for methods and apparatus operable to facilitate high speed optical signal processing also escalates. Various devices and methodologies have been developed to provide numerous signal processing capabilities on optical signals. Some of these devices attempt to control a diffraction of an input optical signal to facilitate basic signal processing functions.

One such approach, known as a variable blazed grating, implements a movable diffraction grating that can be selectively displaced to cause a majority of the diffracted input signal to travel in a particular direction. In some aspects of operation, variable blazed gratings operate to reflect or diffract signals along the same signal path as that of an optical signal being input to the grating. If left unchecked, the input and output signals traveling on the same path can interfere with one another, or the output signal could cause complications to the source of the input signal.

SUMMARY OF EXAMPLE EMBODIMENTS

In one embodiment, a light processing system comprises an optical tap that is operable to receive an unmodulated optical signal and to separate the unmodulated optical signal into a first signal part and a second signal part. The system also comprises a light pipe that is operable to communicate at least the first signal part for processing. The system further includes an optical signal separator that is operable to receive at least the first signal part and to direct at least a portion of the first signal part for modulation by an array of optical signal processing devices. The array of optical signal processing devices are located on one or more semiconductor substrates. The processing devices are operable to receive at least some of the portion of the first signal part and to modulate that portion of the first signal part based at least in part on a control signal received from a controller. At least some of the optical signal processing devices comprise an inner conductive layer that comprises an at least substantially conductive material. Moreover, at least some of the optical signal processing devices comprise a plurality of at least partially reflective mirrors that are disposed outwardly from the inner conductive layer. The mirrors are operable to receive at least some of the portion of the first signal part. In one particular embodiment, at least some of the mirrors are

2

embodiment of an apparatus operable to facilitate high speed optical signal processing;

FIGS. **3**a-c are cross-sectional and planar diagrams showing one example of a blazed grating device;

FIGS. **4**a-c are cross-sectional and planar diagrams showing another example of a blazed grating device;

FIGS. **5**a-c are cross-sectional and planar diagrams showing still another example of a blazed grating device;

FIGS. **6**a-c are cross-sectional and planar diagrams showing yet another example of a blazed grating device;

FIGS. **7**a and **7**b illustrate blazed grating based variable optical attenuators;

FIG. **8** is a block diagram showing a combination of a variable blazed grating and an optical circulator;

FIGS. **9**a-**9**b are block diagrams illustrating examples of blazed grating based 1×2 optical switches;

FIGS. **10**a-**10**d are block diagrams illustrating various modes of operation of a blazed grating based 2×2 optical switch;

FIGS. **11**a-**11**b are block diagrams illustrating examples of various embodiments of blazed grating based optical add/drop multiplexers;

FIG. **12** is a block diagram showing one example of a novel system for facilitating multiple-wavelength signal processing;

FIGS. **13**a-**13**b are block diagrams illustrating examples of various embodiments of a blazed grating based optical gain equalizer;

FIGS. **14**a and **14**b are block diagrams illustrating example embodiments of blazed grating based wavelength division optical add/drop multiplexer;

'714 Patent, col. 1 ll. 19-24.

The ’714 Examiner’s Rejections

The '714 Examiner's Mode of Claim Interpretation Differed from that of this Court

Manual of PATENT EXAMINING PROCEDURE

Original Eighth Edition, August 2001
Latest Revision August 2005

While the claims of issued patents are interpreted in light of the specification, prosecution history, prior art and other claims, this is not the mode of claim interpretation to be applied during examination. During examination, the claims must be interpreted as broadly as their terms reasonably allow.

Manual of PATENT EXAMINING PROCEDURE

Original Eighth Edition, August 2001
Latest Revision August 2006

**>Although< claims of issued patents are interpreted in light of the specification, prosecution history, prior art and other claims, this is not the mode of claim interpretation to be applied during examination. During examination, the claims must be interpreted as broadly as their terms reasonably allow.

The Technical Field of the '714 Patent Has Nothing to Do with Display Art

TECHNICAL FIELD OF THE INVENTION

This invention relates in general to the field of electro-optical systems and more particularly to a system and method capable of using an optical router having one or more all-optical logic gates.

'714 Patent, col. 1 ll. 19-24.

"Patent claims are construed as they would be understood by persons experienced in the field of the invention . . . ."

***Cias, Inc. v. Alliance Gaming Corp.*, 504 F.3d 1356, 1359 (Fed. Cir. 2007).**

The Technical Field of the '714 Patent Has Nothing to Do with Display Art

In the 28 columns of the '714 patent, displays are not mentioned once.

Displays are not mentioned in the 44 columns of the '862 patent either.

Dr. Islam Did Not Agree that the '714 Patent Covered Displays

All of Applicant's arguments and amendments are without prejudice or disclaimer. Additionally, Applicant has merely discussed example distinctions from the *Li*, *Ouchi*, *Yamazaki*, and *Silverstein* references. Other distinctions may exist, and Applicants reserve the right to discuss these additional distinctions in a later Response or on Appeal, if appropriate. By not responding to additional statements made by the Examiner, Applicants do not acquiesce to the Examiner's additional statements. The example distinctions discussed by Applicants are sufficient to overcome the anticipation and obviousness rejections.

All of Applicant's arguments and amendments are without prejudice or disclaimer. Additionally, Applicant has merely discussed example distinctions from the *Dewald* and *Shin* references. Other distinctions may exist, and Applicant reserves the right to discuss these additional distinctions in a later Response or on Appeal, if appropriate. By not responding to additional statements made by the Examiner, Applicant does not acquiesce to the Examiner's additional statements. The example distinctions discussed by Applicant are sufficient to overcome the anticipation and obviousness rejections.

Cheetah's Prosecution History Argument Has No Application to the '862 Patent

- The '862 patent examiner did not cite any display prior art

- The '862 patent is unrelated to the '714 patent

- Prosecution history from an unrelated patent has no effect on the meaning of the '862 patent

Pfizer Inc. v. Ranbaxy Labs., 457 F.3d 1284, 1290 (Fed. Cir. 2006) ("[S]tatements made during prosecution of the later, unrelated [] patent cannot be used to interpret claims of the []patent[-in-suit].").

Optical Signal

'862 Claim 13: "Optical Signal"

13. A method of processing multiple wavelengths of light, the method comprising:

communicating an optical signal for processing, the optical signal comprising a plurality of wavelengths

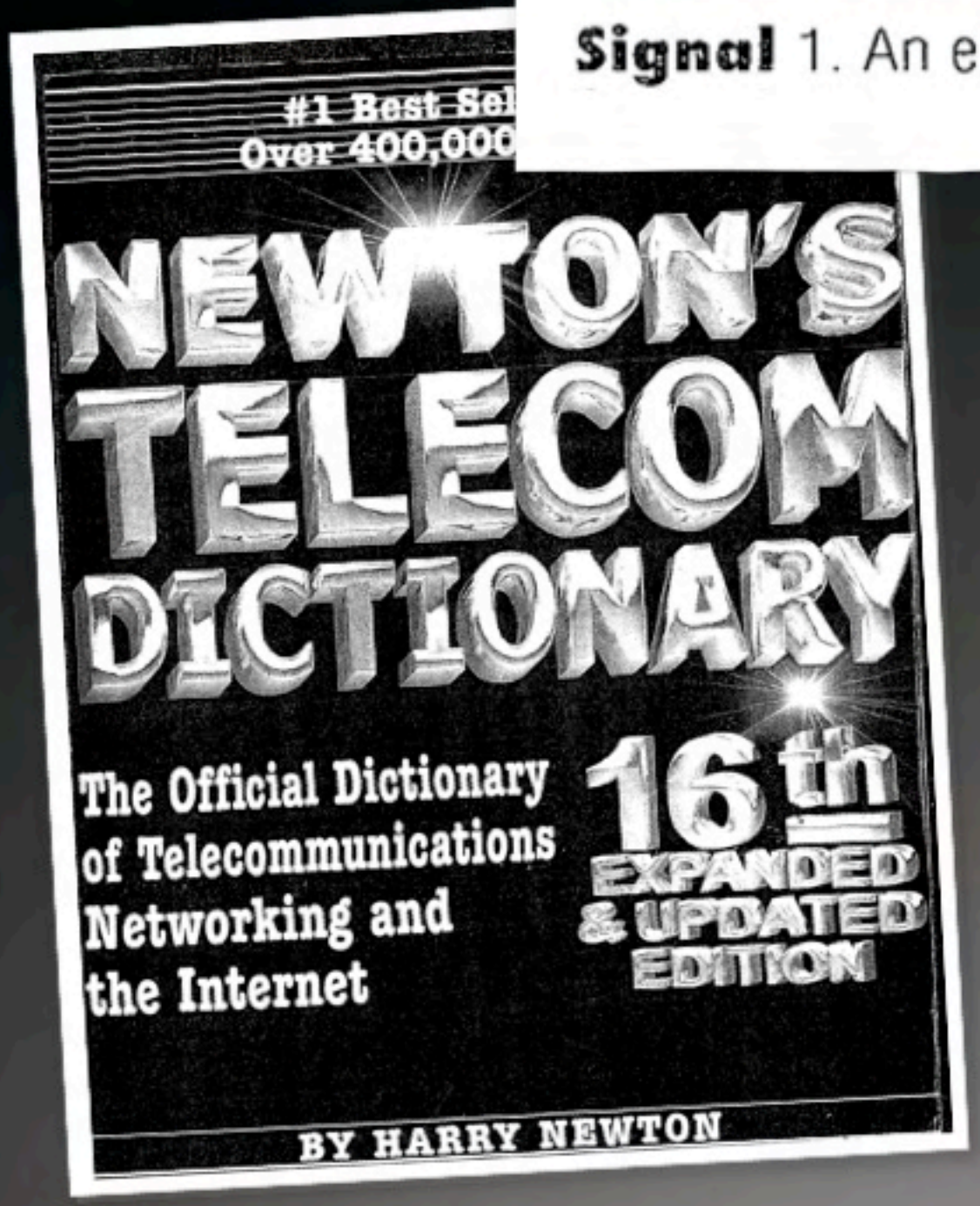
'862 Claim 13: "Optical Signal"

Cheetah's Construction	Defendants' Construction
Light of more than one wavelength*	Light beam carrying information

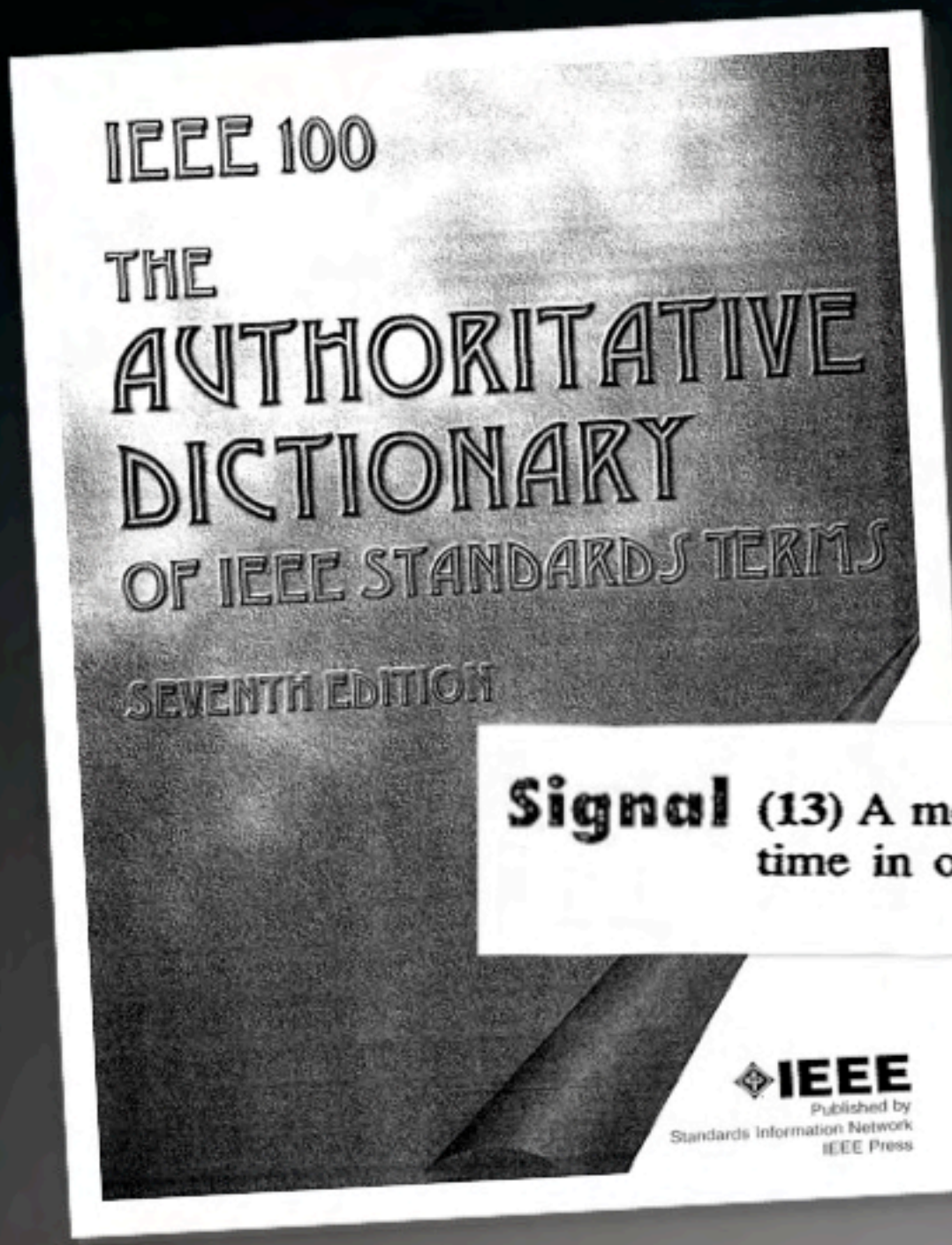
* Cheetah construes the entire phrase "an optical signal for processing, the optical signal comprising a plurality of wavelengths" to mean "light of more than one wavelength."

A "Signal" Conveys Information (by Definition)

Signal 1. An electrical wave used to convey information.



A “Signal” Conveys Information (by Definition)



Signal (13) A measurable quantity (e.g., a voltage) which varies in time in order to transmit information.

A "Signal" Conveys Information (by Definition)

"A 'signal' implies signaling—that is, the conveyance of information."

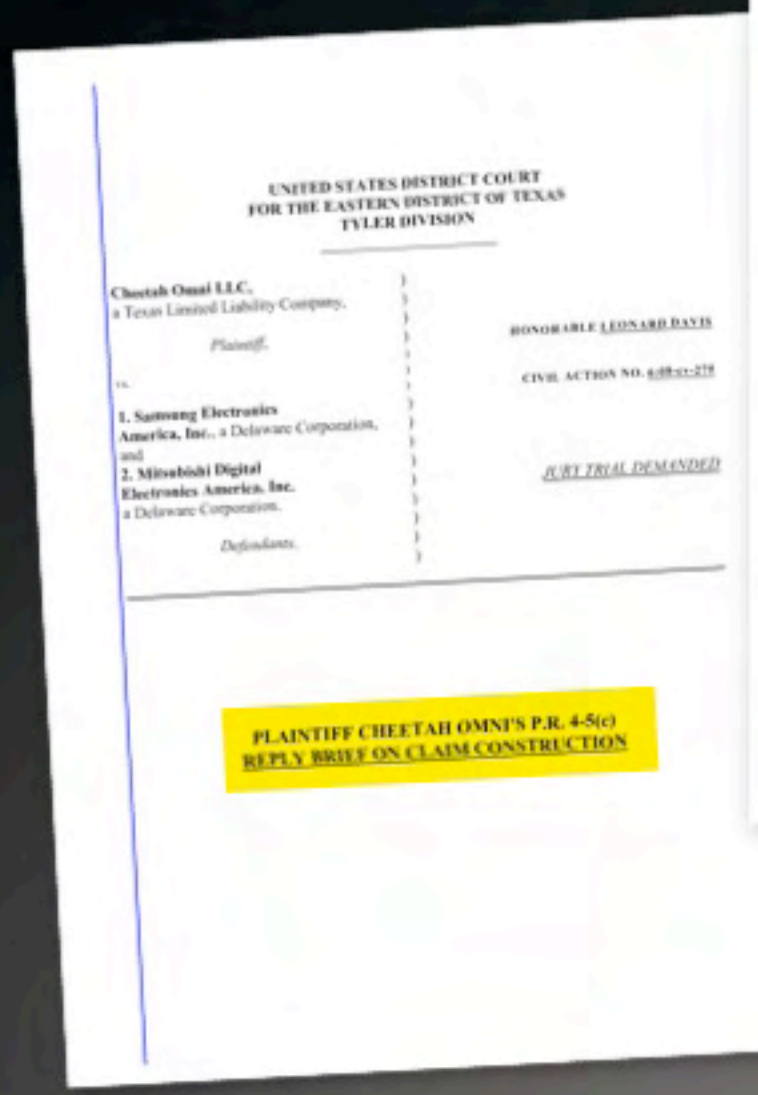
In re Nuijten, 500 F.3d 1346, 1353 (Fed. Cir. 2007).

A "Signal" Conveys Information (by Definition)

IP Innovation, LLC v. Red Hat, Inc., No. 2:07 CV 447, 2009 WL 2460982 (E.D. Tex. Aug. 10, 2009) (Davis, J.).

Disputed Claim Term	Court's Construction
a … signal	[AGREED] - plain and ordinary meaning, an electrical quantity that can be used to transmit information. An example of such a signal is the quantity or value generated by a mouse or keyboard when a button is pressed.

Cheetah Claims a Fiber Optics Dictionary Shows that an "Optical Signal" Need Not Convey Information



UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
TYLER DIVISION

Cheetah Omni LLC,
a Texas Limited Liability Company,

Plaintiff,

vs.

1. Samsung Electronics America, Inc., a Delaware Corporation, and
2. Mitsubishi Digital Electronics America, Inc. a Delaware Corporation,

Defendants.

HONORABLE LEONARD DAVIS

CIVIL ACTION NO. 4:08-cv-273

JURY TRIAL DEMANDED

PLAINTIFF CHEETAH OMNI'S P.R. 4-5(c)
REPLY BRIEF ON CLAIM CONSTRUCTION

PLAINTIFF CHEETAH OMNI'S P.R. 4-5(c)
REPLY BRIEF ON CLAIM CONSTRUCTION

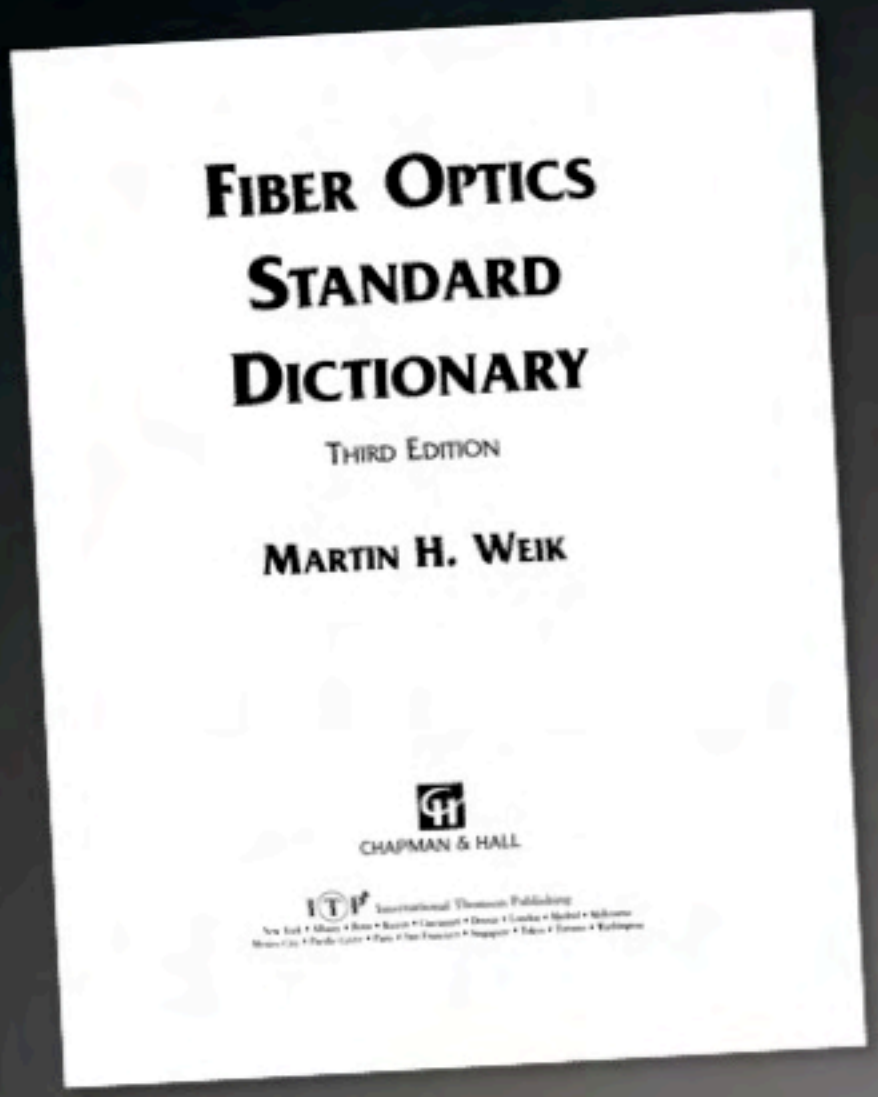
If defendants want to use dictionaries, why don't they cite an **optics** dictionary? The reason is, those dictionaries support Cheetah:

> **optical signal:** A signal that (a) contains optical power and (b) may be transmitted (i) in an optical waveguide, such as an optical fiber, slab, dielectric waveguide, or optical integrated circuit (OIC) or (ii) as a lightbeam in free space.

(Ex. 16, Weik, *Fiber Optics Standard Dictionary*, 3rd Ed. 1997.) This definition is consistent with the PTO's interpretation of the term to cover a lightbeam — without information — transmitted both in an optical waveguide and in free space.

But actually…

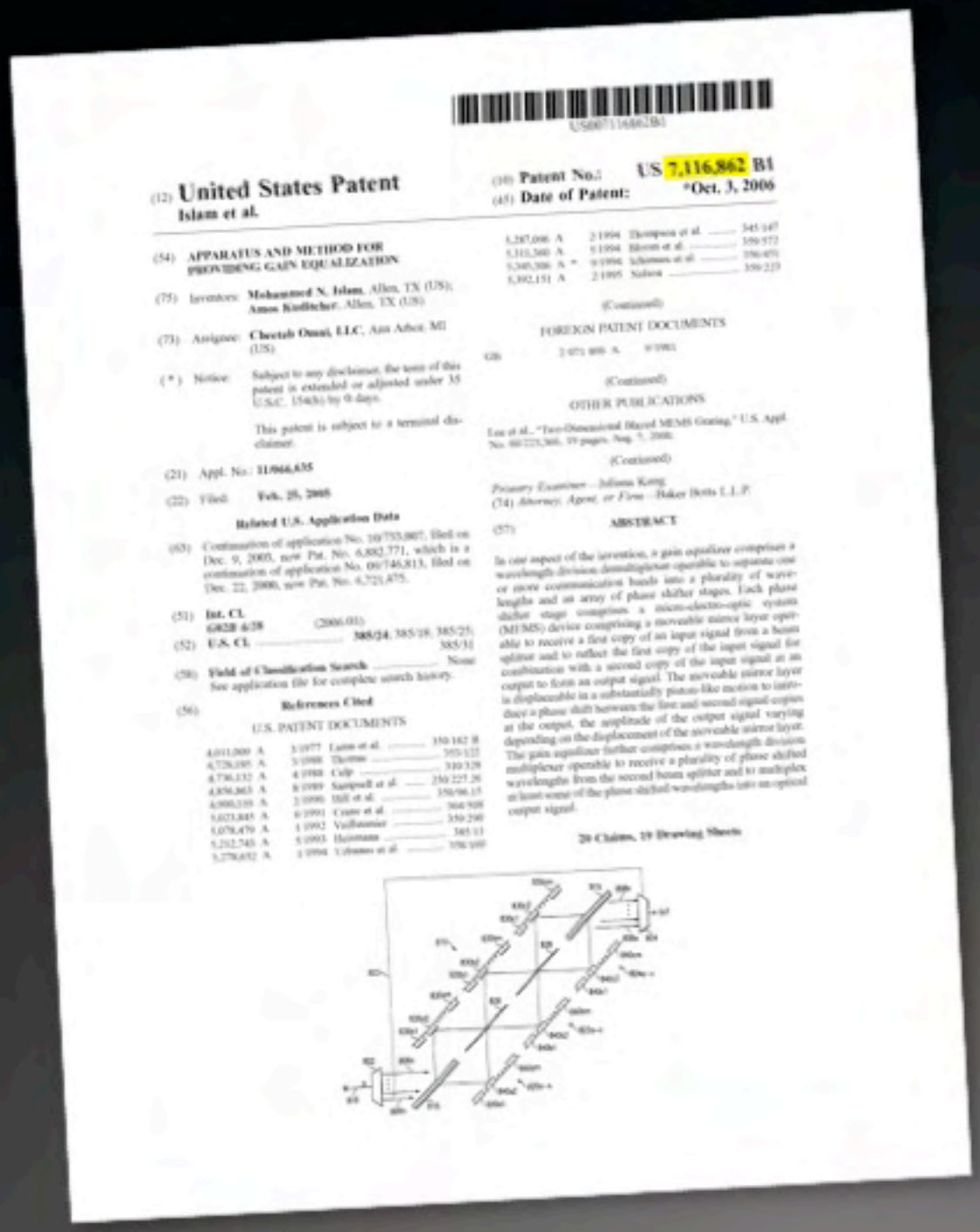
Cheetah's Dictionary Confirms that an "Optical Signal" Carries Information



optical signal: A signal that (a) contains optical power and (b) may be transmitted (i) in an optical waveguide, such as an optical fiber, slab, dielectric waveguide, or optical integrated circuit (OIC) or (ii) as a lightbeam in free space.

signal: **1.** A representation of information conveyed by a carrier. **2.** Detectable transmitted energy that can be used to carry information. **3.** To transmit a sign or symbol for the purpose of conveying information from one point to another. **4.** A time-dependent variation of a characteristic of a physical phenomenon used to convey information. **5.** A transmitted electrical or optical impulse. **6.** A message that (a) consists of one or more symbols, such as letters, words, characters, signal flags, visual displays, or special sounds with prearranged meanings and (b) is conveyed or transmitted by any means, such as visual, acoustical, or electrical means. **7.** The code or pulse that represents intelligence, a message, or a control function conveyed over a communications system. **8.** A visual or mechanical action to which meaning is assigned, such as puffs of smoke; sunlight flashed from a mirror; displays; motion of flags or pennants; or motion of a cable, wire, or rope. *See*

Every Optical Signal Discussed in the '862 Patent Communicates Information



(12) **United States Patent**
Islam et al.

(10) **Patent No.: US 7,116,862 B1**
(45) **Date of Patent: *Oct. 3, 2006**

(54) **APPARATUS AND METHOD FOR PROVIDING GAIN EQUALIZATION**

(75) Inventors: **Mohammed N. Islam**, Allen, TX (US); **Amos Kiolbelcher**, Allen, TX (US)

(73) Assignee: **Cheetah Omni, LLC**, Ann Arbor, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/066,635**

(22) Filed: **Feb. 25, 2005**

Related U.S. Application Data

(63) Continuation of application No. 10/755,807, filed on Dec. 9, 2003, now Pat. No. 6,882,771, which is a continuation of application No. 09/746,813, filed on Dec. 22, 2000, now Pat. No. 6,721,475.

(51) **Int. Cl.**
G02B 6/28 (2006.01)

(52) **U.S. Cl.** **385/24**; 385/18; 385/25; 385/31

(58) **Field of Classification Search** ..... None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,011,009	A	3/1977	Lanni et al.	350/162 R
4,728,185	A	3/1988	Thelen	355/125
4,736,132	A	4/1988	Culp	310/329
4,856,863	A	8/1989	Sampsell et al.	350/27.29
4,900,135	A	2/1990	Hill et al.	350/96.15
5,023,845	A	6/1991	Crane et al.	364/505
5,078,479	A	1/1992	Vuilleumier	350/260
5,212,745	A	5/1993	Heinmann	385/11
5,278,652	A	1/1994	Urbanus et al.	358/160
5,287,096	A	2/1994	Thompson et al.	345/147
5,311,360	A	5/1994	Bloom et al.	359/572
5,345,306	A *	9/1994	Ichimura et al.	356/451
5,392,151	A	2/1995	Nelson	359/223

(Continued)

FOREIGN PATENT DOCUMENTS

GB 2 071 909 A 9/1981

(Continued)

OTHER PUBLICATIONS

Lee et al., "Two-Dimensional Blazed MEMS Grating," U.S. Appl. No. 60/225,360, 19 pages, Aug. 7, 2000.

(Continued)

Primary Examiner—Juliana Kang
(74) *Attorney, Agent, or Firm*—Baker Botts L.L.P.

(57) **ABSTRACT**

In one aspect of the invention, a gain equalizer comprises a wavelength division demultiplexer operable to separate one or more communication bands into a plurality of wavelengths and an array of phase shifter stages. Each phase shifter stage comprises a micro-electro-optic system (MEMS) device comprising a moveable mirror layer operable to receive a first copy of an input signal from a beam splitter and to reflect the first copy of the input signal for combination with a second copy of the input signal at an output to form an output signal. The moveable mirror layer is displaceable in a substantially piston-like motion to introduce a phase shift between the first and second signal copies at the output, the amplitude of the output signal varying depending on the displacement of the moveable mirror layer. The gain equalizer further comprises a wavelength division multiplexer operable to receive a plurality of phase shifted wavelengths from the second beam splitter and to multiplex at least some of the phase shifted wavelengths into an optical output signal.

20 Claims, 19 Drawing Sheets

TECHNICAL FIELD OF THE INVENTION

The present invention relates to the field of communication systems, and more particularly to an apparatus and method for providing gain equalization to optical signals carrying a plurality of wavelengths.

'862 Patent, col. 1 ll. 25-28.

optical communication systems often communicate information using multiple wavelengths multiplexed into one or several optical signals. Current filter technology often becomes a limiting factor in the number of optical wavelengths that can be communicated in any given signal. For example, a filter at the receiving end of the transmission system should be capable of at least substantially isolating each wavelength carrying information from its neighboring wavelengths.

'862 Patent, col. 29 ll. 44-52.

This aspect of the invention provides significant cost savings in processing signals carrying information on multiple channels or wavelengths.

'862 Patent, col. 35 ll. 54-57.

Cheetah Reads Out the Word "Signal" from "Optical Signal"

Limitation construed by Cheetah:

An **optical signal** for processing, the optical signal *comprising a plurality of wavelengths*

Cheetah's construction:

Light *of more than one wavelength*

Cheetah's Position: "Optical Signal" = Light

The Term "Optical Signal" Does Not Refer to Ordinary Light

≠ "Optical Signal"

Cheetah Reads Out the Word "Signal" from "Optical Signal"

Cheetah's Position: Optical Signal = Light

???

Defendants' Construction Gives "Optical Signal" Its Ordinary Meaning

Optical Signal

Light Beam

Carrying Information

Defendants' Construction

'714 Claims 18 & 19: "Optical Signal"

18. A light processing system, comprising:

an optical divider operable to receive an unmodulated optical signal and to separate the unmodulated optical signal into a first signal part and a second signal part

19. A method of processing one or more optical signals, the method comprising:

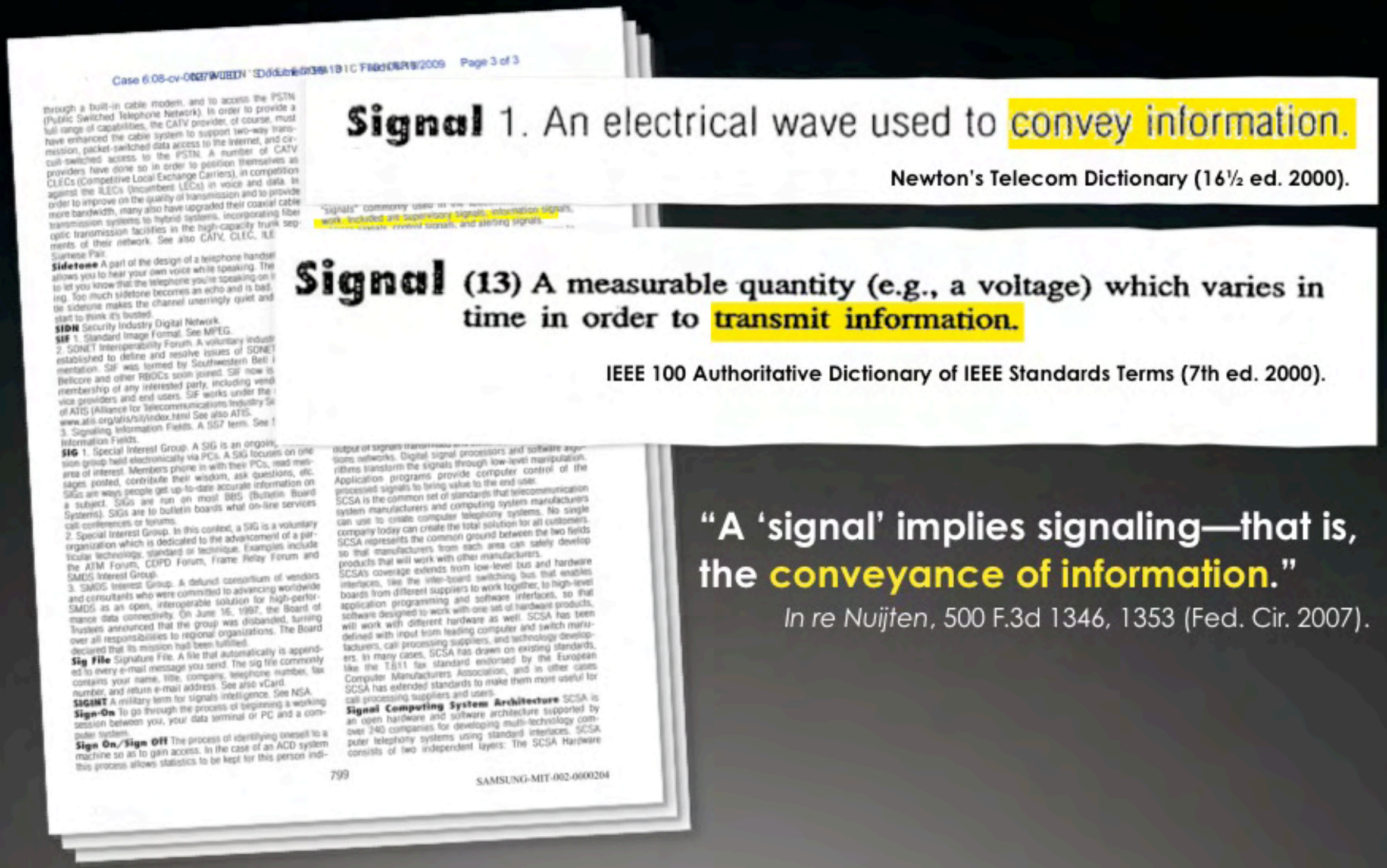
separating an optical signal into a first signal part and a second signal part

'714 Claims 18 & 19: "Optical Signal"

Cheetah's Construction	Defendants' Construction
Light of more than one wavelength*	Light beam carrying information

* Cheetah construes both the term "unmodulated optical signal" in claim 18 and the term "optical signal" in claim 19 to mean "light of more than one wavelength."

A "Signal" Conveys Information (by Definition)



Signal 1. An electrical wave used to convey information.

Newton's Telecom Dictionary (16½ ed. 2000).

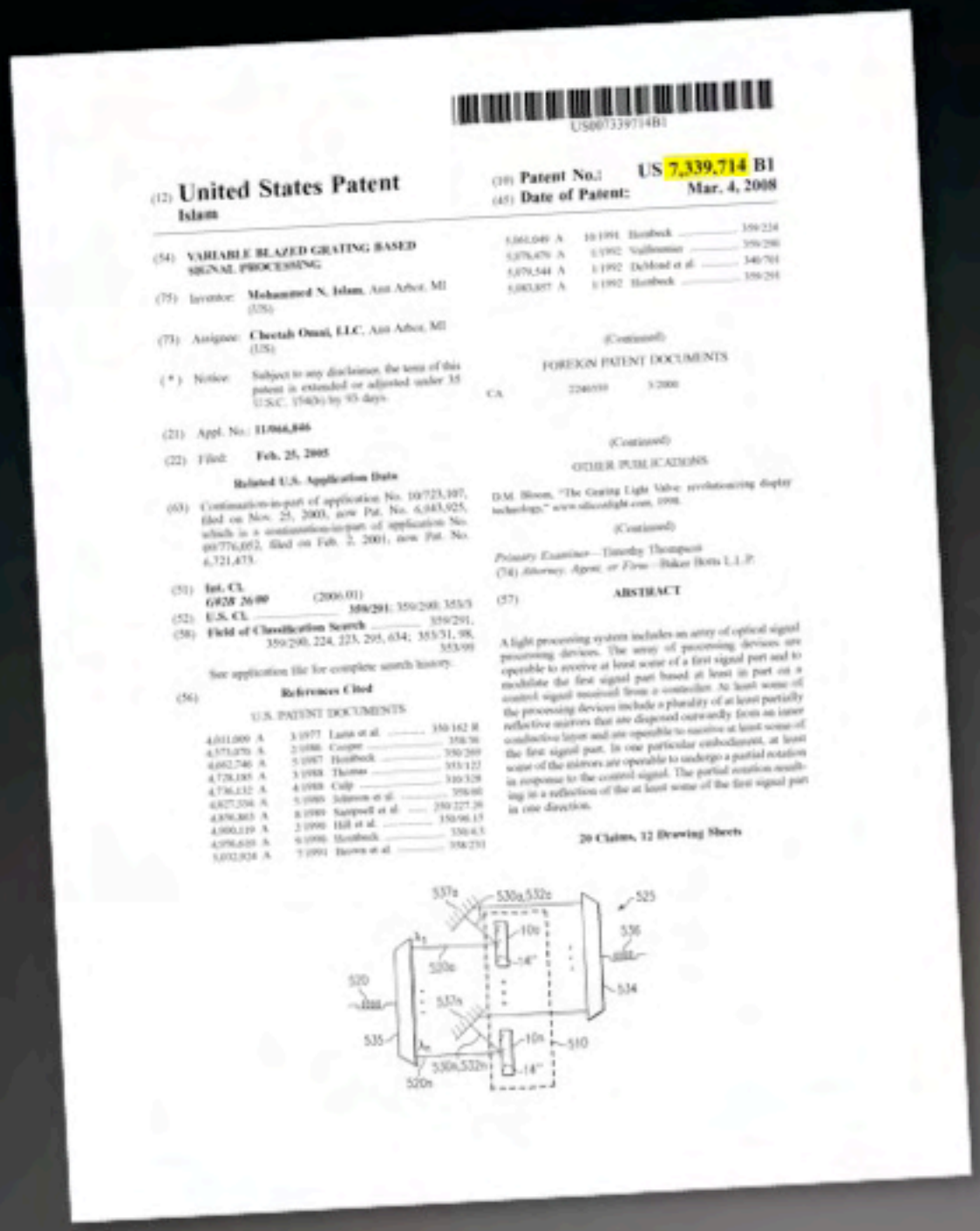
Signal (13) A measurable quantity (e.g., a voltage) which varies in time in order to transmit information.

IEEE 100 Authoritative Dictionary of IEEE Standards Terms (7th ed. 2000).

"A 'signal' implies signaling—that is, the conveyance of information."

In re Nuijten, 500 F.3d 1346, 1353 (Fed. Cir. 2007).

Every Optical Signal Discussed in the '714 Patent Communicates Information



US007339714B1

(12) **United States Patent**
Islam

(10) **Patent No.: US 7,339,714 B1**
(45) **Date of Patent: Mar. 4, 2008**

(54) **VARIABLE BLAZED GRATING BASED SIGNAL PROCESSING**

(75) Inventor: **Mohammed N. Islam**, Ann Arbor, MI (US)

(73) Assignee: **Cheetah Omni, LLC**, Ann Arbor, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 93 days.

(21) Appl. No.: **11/066,846**

(22) Filed: **Feb. 25, 2005**

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/723,107, filed on Nov. 25, 2003, now Pat. No. 6,943,925, which is a continuation-in-part of application No. 09/776,662, filed on Feb. 2, 2001, now Pat. No. 6,721,473.

(51) **Int. Cl.**
G02B 26/00 (2006.01)

(52) **U.S. Cl.** **359/291**; 359/290; 353/3

(58) **Field of Classification Search** 359/291, 359/290, 224, 223, 295, 634; 353/31, 98, 353/99

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,011,009	A	3/1977	Lama et al.	350/162 R
4,571,070	A	2/1986	Cooper	350/269
4,692,746	A	5/1987	Heidbreder	353/122
4,728,185	A	3/1988	Thomas	350/328
4,736,132	A	4/1988	Culp	350/60
4,827,356	A	5/1989	Johnson et al.	250/227.20
4,870,365	A	8/1989	Sampsell et al.	350/96.15
4,900,139	A	2/1990	Hill et al.	350/4.5
4,956,610	A	9/1990	Heidbreder	350/253
5,032,824	A	7/1991	Brown et al.	

5,061,049	A	10/1991	Heidbreder	359/224
5,078,479	A	1/1992	Vuilleumier	359/290
5,079,544	A	1/1992	DeMond et al.	340/701
5,083,857	A	1/1992	Heidbreder	359/291

(Continued)

FOREIGN PATENT DOCUMENTS

CA	2240310	3/2000

(Continued)

OTHER PUBLICATIONS

D.M. Bloom, "The Grating Light Valve: revolutionizing display technology," www.siliconlight.com, 1998.

(Continued)

Primary Examiner—Timothy Thompson
(74) *Attorney, Agent, or Firm*—Baker Botts L.L.P.

(57) **ABSTRACT**

A light processing system includes an array of optical signal processing devices. The array of processing devices are operable to receive at least some of a first signal part and to modulate the first signal part based at least in part on a control signal received from a controller. At least some of the processing devices include a plurality of at least partially reflective mirrors that are disposed outwardly from an inner conductive layer and are operable to receive at least some of the first signal part. In one particular embodiment, at least some of the mirrors are operable to undergo a partial rotation in response to the control signal. The partial rotation resulting in a reflection of the at least some of the first signal part in one direction.

20 Claims, 12 Drawing Sheets

OVERVIEW

As optical systems continue to increase the volume and speed of information communicated, the need for methods and apparatus operable to facilitate high speed optical signal processing also escalates.

'714 Patent, col. 1 ll. 28-31.

This aspect of the invention provides significant cost savings in processing signals carrying information on multiple channels or wavelengths.

'714 Patent, col. 18 ll. 65-67.

Optical signal **1012** comprises header information **1014** and signal payload **1016**.

'714 Patent, col. 20 ll. 35-36.

Every Optical Signal Discussed in the '714 Patent Communicates Information

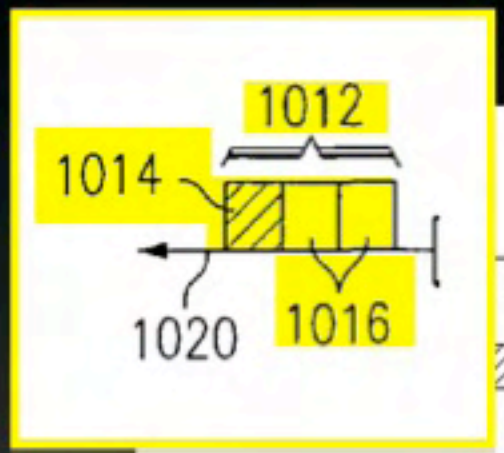


FIG. 15

Optical signal **1012** comprises header information **1014** and signal payload **1016**.

Cheetah Reads Out the Word "Signal" from "Optical Signal"

Cheetah's Position: Optical Signal = Light

???

Defendants' Construction Gives "Optical Signal" Its Ordinary Meaning

Optical Signal

Light Beam

Carrying Information

Defendants' Construction

Output Interface

'862 Claim 13: "Output Interface"

13. A method of processing multiple wavelengths of light, the method comprising:

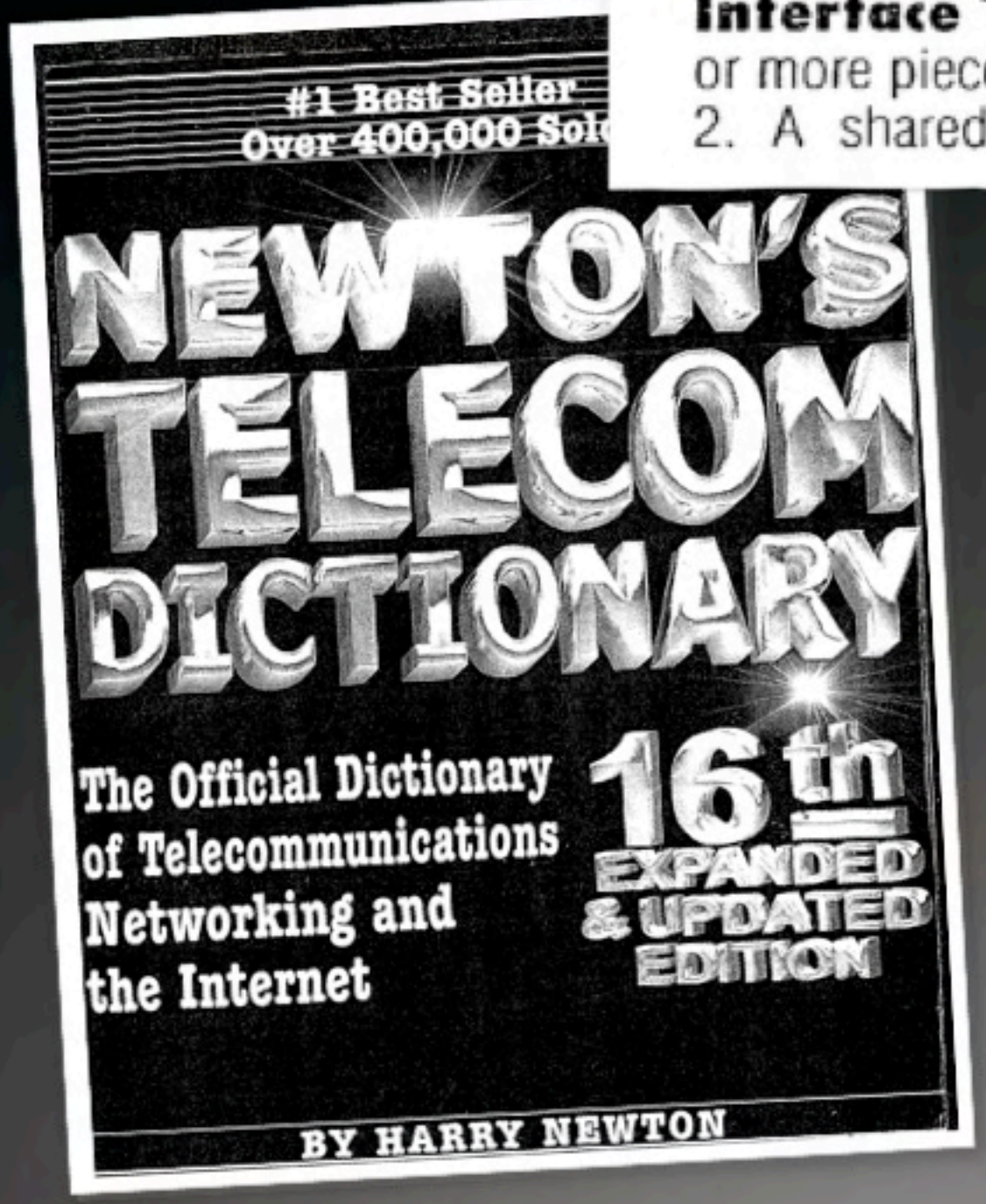
. . . communicating the at least one MEMS output signal to an output interface

’862 Claim 13: “Output Interface”

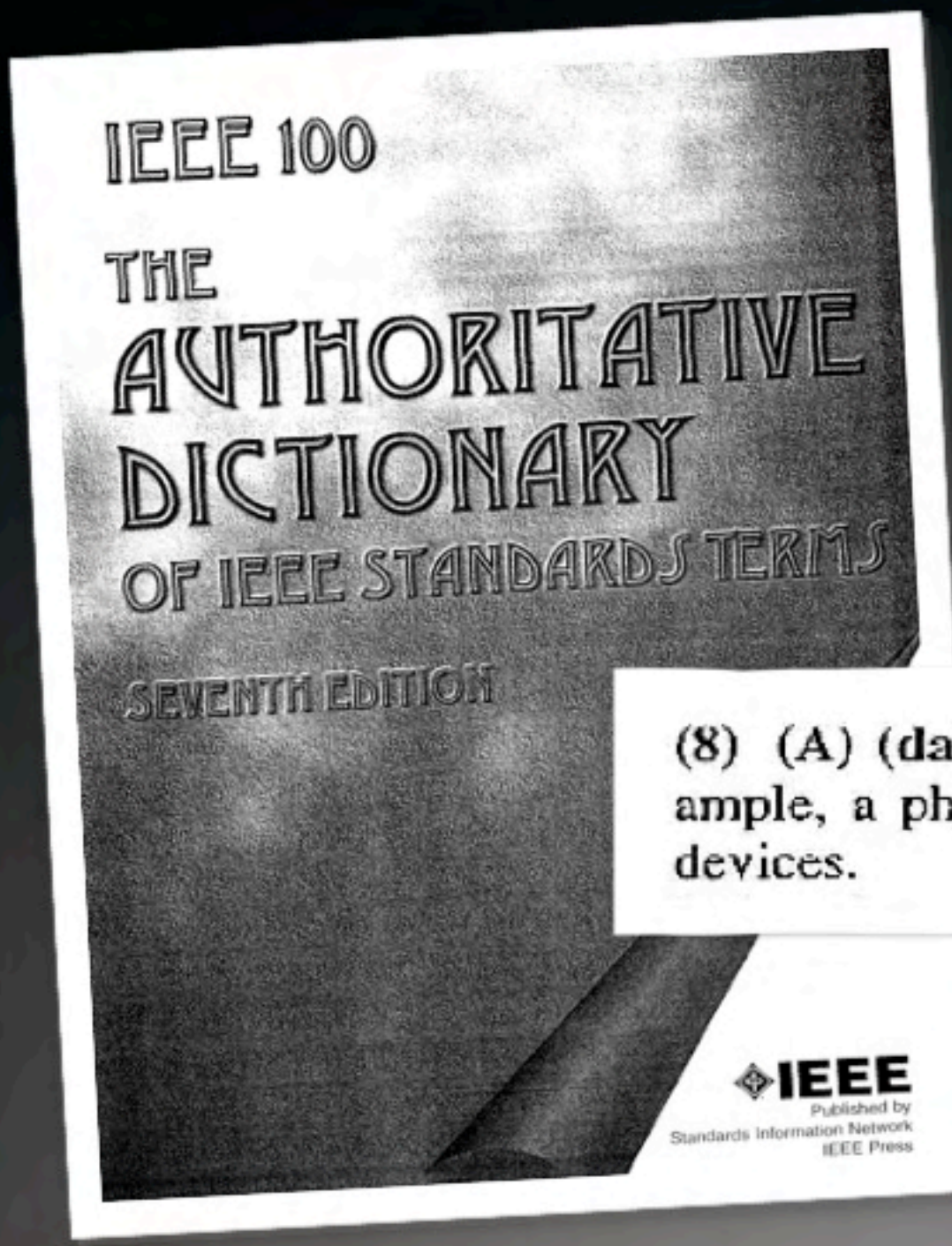
Cheetah’s Construction	Defendants’ Construction
The portion of the system that receives the output signal	Output port for connecting to another system or device

An "Interface" Connects Systems or Devices Together (by Definition)

Interface 1. A mechanical or electrical link connecting two or more pieces of equipment together.
2. A shared boundary. A physical point of demarcation



An “Interface” Connects Systems or Devices Together (by Definition)



(8) (A) (**data transmission**) A common boundary; for example, a physical connection between two systems or two devices.

An "Interface" Connects Systems or Devices Together (by Definition)

"An interface is . . . the means necessary to connect and communicate between two parts of a system."

Rackman v. Microsoft Corp., 102 F. Supp. 2d 113, 125 (E.D.N.Y. 2000).

Cheetah Reads Out the Word "Interface" from "Output Interface"

Cheetah's Position:

Output Interface = The portion of the system that receives the output signal

???

Defendants' Construction Gives "Output Interface" Its Ordinary Meaning

Output Interface

Output port

for connecting to another system or device

Defendants' Construction

'714 Claims 18 and 19: "Output Interface"

18. A light processing system, comprising:

. . . the optical reflector operable to receive at least some of the modulated first signal part and communicate the at least some of the modulated first signal part to an output interface

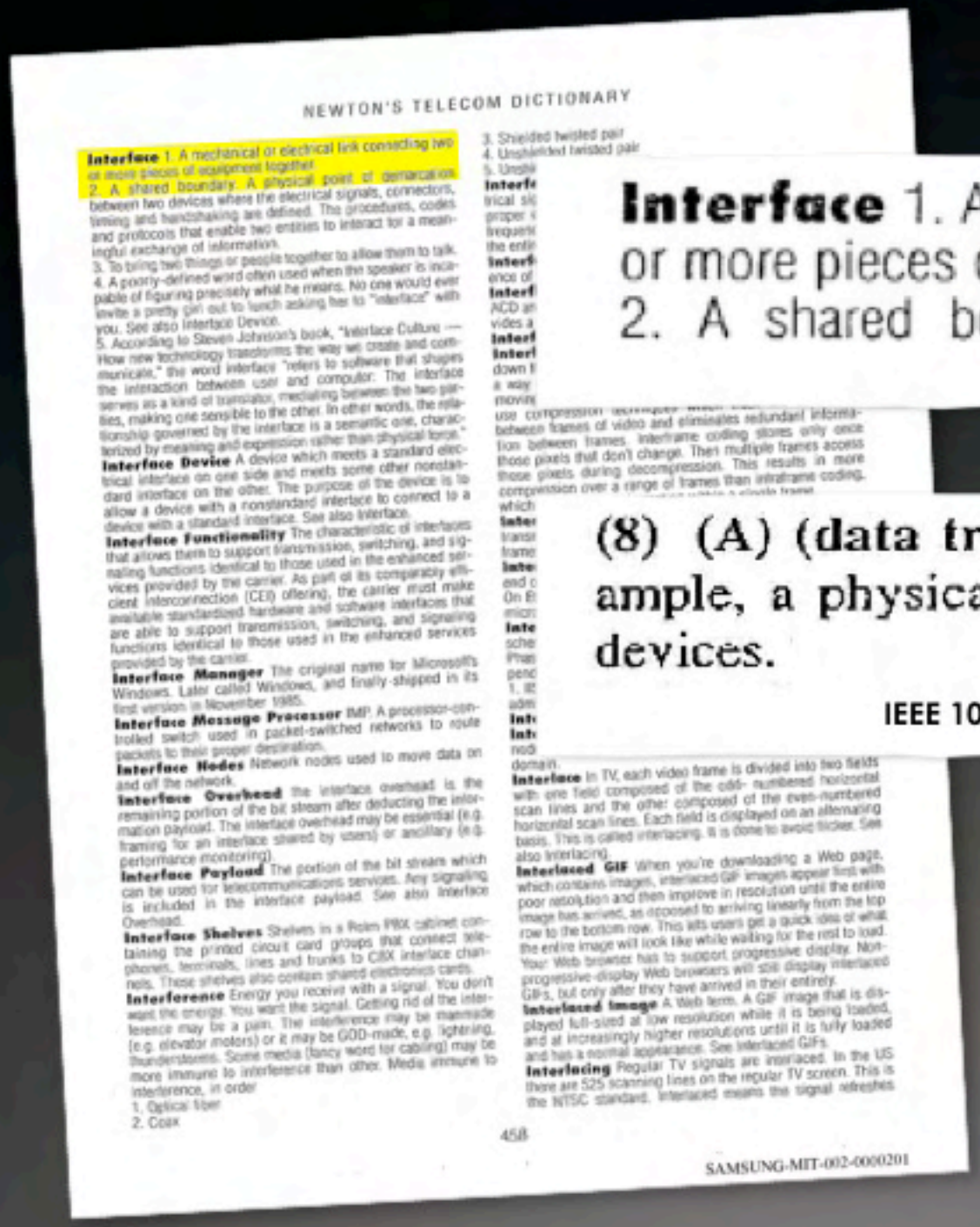
19. A method of processing one or more optical signals, the method comprising:

. . . communicating at least some of the reflected first position of the first signal part to an output interface

'714 Claims 18 and 19: "Output Interface"

Cheetah's Construction	Defendants' Construction
The portion of the system that receives the output signal	Output port for connecting to another system or device

An "Interface" Connects Systems or Devices Together (by Definition)


NEWTON'S TELECOM DICTIONARY

Interface 1. A mechanical or electrical link connecting two or more pieces of equipment together.
2. A shared boundary. A physical point of demarcation between two devices where the electrical signals, connectors, timing and handshaking are defined. The procedures, codes and protocols that enable two entities to interact for a meaningful exchange of information.
3. To bring two things or people together to allow them to talk.
4. A poorly-defined word often used when the speaker is incapable of figuring precisely what he means. No one would ever invite a pretty girl out to lunch asking her to "interface" with you. See also Interface Device.
5. According to Steven Johnson's book, "Interface Culture — How new technology transforms the way we create and communicate," the word interface "refers to software that shapes the interaction between user and computer. The interface serves as a kind of translator, mediating between the two parties, making one sensible to the other. In other words, the relationship governed by the interface is a semantic one, characterized by meaning and expression rather than physical force."

Interface Device A device which meets a standard electrical interface on one side and meets some other nonstandard interface on the other. The purpose of the device is to allow a device with a nonstandard interface to connect to a device with a standard interface. See also Interface.

Interface Functionality The characteristic of interfaces that allows them to support transmission, switching, and signaling functions identical to those used in the enhanced services provided by the carrier. As part of its comparably efficient interconnection (CEI) offering, the carrier must make available standardized hardware and software interfaces that are able to support transmission, switching, and signaling functions identical to those used in the enhanced services provided by the carrier.

Interface Manager The original name for Microsoft's Windows. Later called Windows, and finally shipped in its first version in November 1985.

Interface Message Processor IMP. A processor-controlled switch used in packet-switched networks to route packets to their proper destination.

Interface Nodes Network nodes used to move data on and off the network.

Interface Overhead the interface overhead is the remaining portion of the bit stream after deducting the information payload. The interface overhead may be essential (e.g. framing for an interface shared by users) or ancillary (e.g. performance monitoring).

Interface Payload The portion of the bit stream which can be used for telecommunications services. Any signaling is included in the interface payload. See also Interface Overhead.

Interface Shelves Shelves in a Rolm PBX cabinet containing the printed circuit card groups that connect telephones, terminals, lines and trunks to CBX interface channels. These shelves also contain shared electronics cards.

Interference Energy you receive with a signal. You don't want the energy. You want the signal. Getting rid of the interference may be a pain. The interference may be manmade (e.g. elevator motors) or it may be GOD-made, e.g. lightning, thunderstorms. Some media (fancy word for cabling) may be more immune to interference than other. Media immune to interference, in order
1. Optical fiber
2. Coax
3. Shielded twisted pair
4. Unshielded twisted pair

Interface In TV, each video frame is divided into two fields with one field composed of the odd- numbered horizontal scan lines and the other composed of the even-numbered horizontal scan lines. Each field is displayed on an alternating basis. This is called interlacing. It is done to avoid flicker. See also Interlacing.

Interlaced GIF When you're downloading a Web page, which contains images, interlaced GIF images appear first with poor resolution and then improve in resolution until the entire image has arrived, as opposed to arriving linearly from the top row to the bottom row. This lets users get a quick idea of what the entire image will look like while waiting for the rest to load. Your Web browser has to support progressive display. Non-progressive-display Web browsers will still display interlaced GIFs, but only after they have arrived in their entirety.

Interlaced Image A Web term. A GIF image that is displayed full-sized at low resolution while it is being loaded, and at increasingly higher resolutions until it is fully loaded and has a normal appearance. See Interlaced GIFs.

Interlacing Regular TV signals are interlaced. In the US there are 525 scanning lines on the regular TV screen. This is the NTSC standard. Interlaced means the signal refreshes

458

SAMSUNG-MIT-002-0000201

Interface 1. A mechanical or electrical link connecting two or more pieces of equipment together.
2. A shared boundary. A physical point of demarcation

Newton's Telecom Dictionary (16½ ed. 2000).

(8) (A) (**data transmission**) A common boundary; for example, a physical connection between two systems or two devices.

IEEE 100 Authoritative Dictionary of IEEE Standards Terms (7th ed. 2000).

"An interface is . . . the means necessary to connect and communicate between two parts of a system."

Rackman v. Microsoft Corp., 102 F. Supp. 2d 113, 125 (E.D.N.Y. 2000).

The Output Interfaces in the '714 Patent Communicate Data from One System or Device to Another

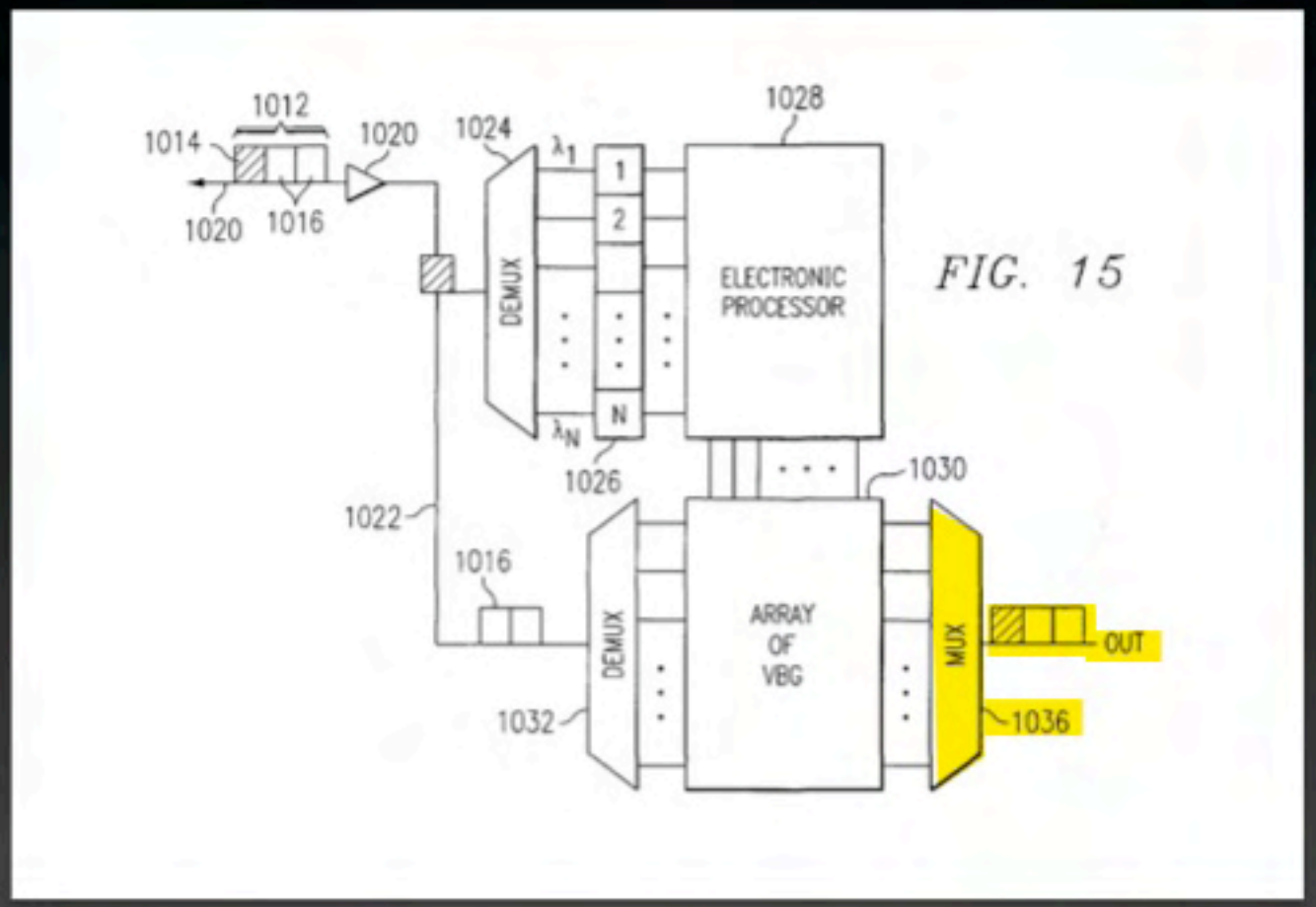


FIG. 15

Multiplexer **1036** receives switched optical signals **1040** from optical add/drop multiplexer array **1030** and transmits the switched optical signals to other network elements.

'714 Patent, col. 21 ll. 29-32.

Cheetah Reads Out the Word "Interface" from "Output Interface"

Cheetah's Position:

Output Interface = The portion of the system that receives the output signal

???

Defendants' Construction Gives "Output Interface" Its Ordinary Meaning

Output Interface

Output port

for connecting to another system or device

Defendants' Construction